AGRICULTURAL DIRECTORATE, MESOPOTAMIA.

A NOTE ON

THE WHEATS AND BARLEYS

OF

MESOPOTAMIA,

TOGETHER WITH OBSERVATIONS ON LOCAL CONDITIONS

BY

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THE WHEATS AND BARLEYS

OF

MESOPOTAMIA.

In the course of the Survey of the Wheats and Barleys on the Euphrates, Tigris and Karun this year the following points were brought out:—

(I) Iraq is capable of producing the finest quality of hard strong bread wheat and plump malting barley.

(II) Rust epidemics are late in appearing and early maturing varieties of wheat suffer least damage.

(III) The preference for barley instead of wheat in irrigated tracts, roughly definable as the area south of the Jabel Hamrin is very largely due to the uncertainty of the wheat crop resulting from severe epidemic of rust.

(IV) Growth of T. vulgare wheats under the Daim (growth of a crop on the natural rainfall) conditions, obtaining south of Jabel Hamrin conferred practical resistance to rust.

(V) This practical resistance did not hold in the regular daim areas of greater rainfall roughly defined by the boundaries of the Mosul Vilayat. Here the susceptibility of T. vulgare wheats to rust even under daim conditions drives the cultivator to the utilisation of T. durum wheats of greater rust resistance and possibly also of greater drought resisting powers.

(VI) For daim conditions the two rowed black barley has no rivals probably entirely on account of its drought resistant powers. On the Karun a European demand for white and malting barley has been responded to by the growth of a certain amount of two rowed whites

Bearing in mind that present conditions are only a passing phase and that with about another three years of settled Government Iraq will be flooded with grain and be seeking on export market, a wheat and barley survey was of prime importance to determine what strains occurred in the country having characteristics that would be of value in building up the types of these cereals which must be substituted for present mixtures if an export market is to be sought with success.

The demand of the home biscuit trade for Karun wheat has already produced quantities of fairly homogeneous good quality wheat, while by screening, good samples of malting barley have also been shipped from the Karun. This pre-war trade was largely in the hands of Messrs. Strick Scott & Co. and I am indebted to the grain Department Assistant employed by this firm at Mohammerah, whom I was able to interview by the courtesy of their Basrah Manager, for the following information as to the requirements of the European market.

WHEAT.

English demand unlimited for a small, hard red plump grain of rather flinty cross section.

Continental markets show a preference for a small plump white grain of rather flinty cross section.

MALTING BARLEY

should be plump, with a wrinkled thin skin, of bright light straw colour and of good germinating capacity.

Requirements therefore are:—

(*i*) A drought and rust resistant strain of T. vulgare wheat which will create a demand on the English market.

(*ii*) A good fat white malting barley suitable for sale in Europe: for feeding purposes it is not likely that anything can be produced to equal the two rowed black already grown.

Other points that need consideration are:—

WHEAT.

Yield, Straw strength and Awned Ears.—Owing to the large bird population, dry atmosphere and length of time over which harvesting operations are spread awnless varieties tend to suffer losses by shedding.

It is considered that efforts should be concentrated on the production of a good T. vulgare wheat for Mosul Vilayat, rather than in introducing improved strains of T. durum. The RESHGUL (Nos. 39 and 51) and SURGUL (Nos. 46 and 47) as grown at present would want a good deal of beating. Improvements, if any, should be found necessary could be brought about by single plant selection from local crops.

BARLEY.

Strong straw.—Native varieties are markedly weak in the straw and severe losses are caused by crops being laid flat by late rains and hails.

Botanical Survey.

A start was made in 1918 by Lt.-Col. Graham on the Euphrates from Hillah to Fellujah and 26 distinct Botanical types were collected. 87 lines, each sown from a single ear were sown by him on the Base Dairy Farm and harvested in the first week of May. I was able to make observations as to rust resistance in April with the result that it was possible to eliminate the majority for their susceptibility to rust. Lines 44, 73, 74, 76, 79, 82, 89, 91 and 102 showed desirable qualities and were grown in bulk this year and inasmuch as it was not possible to conduct observations during the whole period of growth while it was not possible to superintend the whole of the harvesting of the remaining lines, 2 ears of each were sown again this year. Lines 3, 14, 20, 21, 23, 27, 29, 30, 40, 42, 43, 46, 51, 57, 58, 60, 61, 62, 65, 66, 70, 80, 90, 101 and 102 apparently "split" so that ears of the varying types into which they had "split" were also sown.

In view of the fact that the whole of the wheat and barley area irrigated by inundation canals cannot with certainty look for flood irrigation until the end of March, all lines sown this year have been sown under conditions as nearly approaching these as possible

Line 44. Ear smooth, awned, white, lax: grain, small, plump, white, of rather flinty cross section: early maturing and on this account tends to resist rust.

Line 73 Felted red chaff awnless grain amber
74 Felted red chaff awnless grain white
76 Felted red chaff awnless grain white
79 Smooth red chaff awnless grain amber
} early maturing rust resistant strains.

82, 89, 102 } Felted and smooth awnless white chaff with amber and white grains: propagated as containing rust resistant strains.

1919 SURVEY.

Itinerary was arranged as nearly as possible so as to follow the harvest northwards: it was unfortunately not possible to fit in the Karun journey late enough for the Durum Wheats around Shuster to be collected but the barleys and T. vulgare wheats of this tract had ripened.

Route was:—

First week in April	...	Zobeir Daim area.
Third week in April	...	Karun area.
Last week in April	...	Nasiriyah area. Basrah irrigated area.
First week in May	...	Amarah area and Northern Ghurraf.
Second week in May	...	Kut to Baghdad.
Third week in May	...	Baghdad and Hillah area.
Fourth week in May	...	Mosul area.
First week in June	...	
Last week in June	...	Baqubah area (after harvest).

Areas not scoured therefore are Samawah to Diwaniyah, Fellujah to Abu Kemal, Samarrah, Mandali, Badrah, Khanaqin, Kifri and Karkuk. It is considered, however, from tours conducted during this last sowing season that the Misri of Khanaqin is the only variety of commercial importance that has escaped the survey and this season may prove it to be similar to the Sfaira of Amarah and white chaff bearded of Baghdad and Hillah.

A plot of Misri from Khanaqin grown on the Baghdad Dairy Farm in 1918-1919 was very badly attacked by rust. A hairy-leaved so called wild wheat was seen growing in Samarrah in the spring of 1918 but the mature ear was not collected.

T. monococcum reported by Col. Engledow at Mohammad el Hassan near Tikrit has not been collected nor has the naked barley that appeared as a sample at the Amarah Agricultural Show in late 1918.

In classifying the wheats collected the following procedure was adopted:—

Naked eye characters only were utilised and only the following generally accepted stable characters taken:—

Awned and Awnless.
Glumes smooth or glumes felted.
Glumes red, white or black.
Awns red, white or black.
Grain red, amber or white.

The grain characters are considered the least trustworthy and the most liable to fluctuation on account of environment.

The slightest tinge of black present was accounted as black except in the glume character of T. vulgare wheats where blackness was never sufficient to mark whiteness or redness of the glumes. Black colour on the glumes of awnless wheats was not met with.

All wheats observed during the survey belonged to the species Triticum sativum and to the sub-species T. compactum, T. durum and T. vulgare. No specimen could be definitely placed under the sub-species T turgidum though the SURGUL of Mosul (Nos. 46, 47) would appear to approximate very nearly thereto.

The Sinn el Fil of Mosul (No. 50) is rather a far fetched T. durum but rachis is persistent, and the chaff can be winnowed from the grain.

Classification of specimens collected is as follows:—

	Type No.	Photo. No.	Origin.	Vernacular Name.
T. Vulgare (*vide* **Plates 1, 2, 3**).				
EARS AWNLESS.				
GLUMES WHITE.				
(*a*) *Glumes smooth*—				
(i) Grain red	1	1	Basrah	Buwethah.
(ii) „ white	2	2	Hindiyeh	Gareita Buwethah.
(iii) „ amber	3	3	Do.	Do.
(*b*) *Glumes felted*—				
(i) Grain red	4	4	Kut L. Bank ...	Do.
(ii) „ white	5	5	Nasiriyeh	Buwethah.
(iii) „ amber	6	6	Hindiyeh	Gareita, Buwethah.
GLUMES RED.				
(*a*) *Glumes smooth*—				
(i) Grain red	7	7	Nasiriyeh	Do. Hamra.
(ii) „ white	8	8	Shumran	Do. do.
(iii) „ amber ...	9	9	Basrah	Do. do.
(*b*) *Glumes felted*—				
(i) Grain red	10	10	Amara	Deghaimah.
(ii) „ white	11	11	Kut L. Bank ...	Gareita Hamra.
(iii) „ amber	12	12	Baqubah	Do. do.
EARS AWNED.				
(*a*) *Glumes smooth*—				
(i) Grain red	13	13	Zobeir	.....
Glumes bright, yellow, grain red. ...		14	Do.	.....
Spikelets very broad, grain red		15	Hai	Sfaira.
(ii) Grain white	14	16	Nasiriyeh	Araqi.
(iii) „ amber	15	17	Shidthaif	Do.
(*b*) *Glumes felted*—				
(i) Grain red	16	18	Karun	... ..
(ii) „ white	17	19	Nasiriyeh	Binia.
(iii) „ amber	Nil	...	.....	.....

	Type No.	Photo. No.	Origin.	Vernacular Name.
RED AWNED RED GLUMED.				
(*a*) *Glume smooth*—				
(i) Grain red — ...	18	20	Amara	Wuthanah.
(ii) „ white	19	21	Qalat Saleh	Shileech Ahmar.
(iii) „ amber	20	22	Shumran	Hamera.
(*b*) *Glumes felted*—				
(i) Grain red	21	23	Karun	.....
(ii) „ white	Nil	...	.....	.....
(iii) „ amber	22	24	Nasiriyeh	Hamera.
BLACK AWNED WHITE GLUMED.				
(*a*) *Glumes smooth*—				
(i) Grain red	23	25	Do.	Soda Siffa.
(ii) „ white	Nil	...	.....	.....
(iii) „ amber	24	26	Hindiyeh	Soda Siffa.
(*b*) *Glumes felted*—				
(i) Grain red	25	27	Kut	Do.
(ii) „ white	26	28	Narooma	Do.
(iii) „ amber	27	29	Karun	.....
BLACK AWNED RED GLUMED—				
(*a*) *Glumes smooth*—				
(i) Grain Red	28	30	Zobeir	.....
(ii) „ white	Nil	...	.....	.....
(iii) „ amber	29	31	Karun	.....
(*b*) *Glumes felted*—				
(i) Grain red	30	32	Zobeir	Karuni.
(ii) „ white — ...	Nil	...	.....	.....
(iii) „ amber	31	33	Nasiriyeh	Soda Siffa.
T Durum (*vide* Plates 4 and 5).				
WHITE AWNED WHITE GLUMED.				
(*a*) *Glume smooth*—				
(i) Grain red	32	34	Mosul	Buwethah.
(ii) „ white	33	35	„	Ditto.
(iii) „ amber	Nil	...	.....	.....
(*b*) *Glumes felted*—				
(i) Grain red	Nil	...	.....	.....
(ii) „ white	34	36	Shumran	Hurrima.
(iii) „ amber	35	37	Nasiriyeh	Sinn el Fil.
BLACK AWNED BLACK GLUMED.				
(*a*) *Glumes Smooth*—				
(i) Grain red	36	38	Mosul	Reshgul.
(ii) „ white	Nil	...	.....	.....
(iii) „ amber	37	39	Mosul	Reshgul.
(*b*) *Glumes felted*—				
(i) Grain red	38	40	Kut L. Bank ...	Hurrima.
(ii) „ amber	39	41	„ R. „ ...	Hamayshiya.
(iii) „ white	40	42	Shidthaif	Hurrima.
RED AWNED RED GLUMED.				
(*a*) *Glumes Smooth*—				
(i) Grain red	41	43	Amara	Koola.
(ii) „ white — ...	Nil	...	.....	.....
(iii) „ amber	Nil	...	.....	.....
(*b*) *Glumes felted*—				
(i) Grain red	42	44	Kut	Harrima.
(ii) „ amber	43	45	Mosul	Serrgul.
(iii) „ white	Nil	...	.....	.....
BLACK AWNED RED GLUMED.				
(*a*) *Glumes smooth*—				
(i) Grain red	Nil	...	.....	.....
(ii) „ white	44	46	Mosul ...	Surgul.
(iii) „ amber ...	45	47	„	Ditto.
(*b*) *Glumes felted*—				
(i) Grain red	46	48	Narooma	Hurrima.
(ii) „ amber	47	49	Nasiriyeh	Ditto.
(iii) „ white	Nil	...	...	.....
WHITE AWNED BLACK GLUMED.				
(*a*) *Glumes smooth*—				
(i) Grain amber	48	50	Mosul	Sinn el Fil.
BLACK AWNED WHITE GLUMED.				
(*a*) *Glumes smooth*—				
(i) Grain amber	49	51	„	Reshgul.

BARLEY.

Two rowed black	Chevalier	rachilla	...	... (Plate 6 No. 1)
Two rowed white	,,	,,	...	... (,, 6 ,, 2)
Two rowed fantail white		...	...	... (,, 6 ,, 3)
Four rowed white	...	...	...	... (,, 6 ,, 4)
Four rowed black	...	...	...	... (,, 6 ,, 5)
Six rowed white	...	...	...	... (,, 6 ,, 6)

It will be seen from the above list that a most extraordinary wealth of material is at hand.

The wheats and barley imported under the Agricultural Development scheme have already increased the number of types to be found in the country: the large mixture of varying types found is therefore perhaps only to be expected. The marches and counter marches of mighty armies since the dawn of history can but have had the effect of introducing new types.

It should be borne in mind however that a fair number of types collected may be crosses, in view of the fact that 25 per cent. of the Basrah lines split last year. It is more than likely that, in view of the dry atmosphere experienced at the time of fertilisation, a considerable amount of natural cross fertilisation takes place.

Varieties Popular in Specific Districts Together with Local Notes.

ZOBEIR AREA.

The area is noted more for the quality of its wheat than for the quantity it produces. the crops are grown in small patches on specially favoured areas among the uneven ground that marks the site of the old Basrah.

A favoured area is as a rule one which by being situated in a depression gets more than the normal rainfall of the country: in certain cases observed, however, the ability of the land to produce a DAIM crop could not be attributed to this cause and one was obliged to attribute it to more loamy texture of the land resulting in less surface evaporation, freedom from cracking and better moisture conservation: these loamy patches are the result of admixture of broken down bricks, etc., and it seems quite probable that these small pieces of brick form a favourable medium for the development of Nitrifying organisms: on the other hand fertility may be due to accumulation of Nitrate of Potash on an old city site (*c.f.*, the nitrate earth accumulations on the site of the old Baghdad, 2 miles south-west of Khirr Depot) Leguminous weeds were insufficient to restock the land in Nitrogen.

The 1918-1919 wheat crop around Zobeir was all sown in the second week of November following on a heavy early rain: harvesting was complete by the first week in April and grain of all varieties matured in fine plump condition too early in the season for damage by rust to be possible.

A collection of 9 distinct bread wheats, 7 of them of fine quality, was obtained from Zobeir. They possess the characters of drought resistance, good quality strong straw and early maturity: yield and rust resistance under irrigated conditions remain to be tested (*vide* Plate 7).

The favourite variety in the Zobeir area is a white chaff beardless wheat called BWETHAH (Plate 7 No. 1), KARUNI (Plate 7 No. 9) a bearded felted white chaff with blackish awns and fine small hard red grain, comes next in quantity and as its name implies originally came from *Karun*.

KARUN RIVER AREA.

The crops of this area are almost entirely grown on the rainfall and the advantages of these tracts over those situated at similar distances from the sea on the Tigris or Euphrates are at once evident to anyone entering them for first time: at Ahwaz within 120 miles by river from Mohammerah one has conditions of rainfall, etc., almost identical with those obtaining around Beled on the Tigris (*i.e.*, nearly 700 miles up river from Mohammerah). Very little T. durum (or Macaroni) wheat is grown south of Dera Kazineh but from there northwards around Shuster, Macaroni wheats predominate. The majority of these latter crops seemed to obtain a certain small supply of canal water during their growth period and increased rust resistance under irrigated conditions probably leads to their preferment. I was informed that the demand for T. vulgare or bread wheats for the export trade was gradually driving the Macaroni zone further northwards.

In the Karun area generally cultivators reckon on getting two good crops, two indifferent crops and one failure in every five years: the astonishing feature of the Daim wheat and barley tracts is the apparent lack of labour: from Bundekir to Dera Kazineh one passes through a cultivated area of 20 or 30 miles with never a sign of habitation on either side: it appears that cultivators come in from Dizful, Basrah, etc., about sowing time, cultivate their patch, sow and depart, not returning till the crop is ripening to see what luck they have had: a good deal of Bakhtiari labour comes down from the foothills for the harvest.

Hawizeh is accessible from Ahwaz by car but is to-day but a relic of its former glory. The name once signified a town of 30,000 inhabitants on the Kirkha river: the latter having changed its course to the northward about sixty years ago. Hawizeh is now only a small village with scanty cultivation; the glamour of the old town still remains locally however and has passed on its name to the whole tract of country lying to the east of the Hawizeh marshes: this explains the answers of the men who bring up cargoes of Koola or Macaroni wheat over the marshes, *via* the Mashurra to Amarah: in reply to queries as to its origin, they invariably reply from Hawizeh: it appears that this grain is grown round Dizful, Shuster, Shush, etc., and shipped across the marshes from Bisaitin, Kafajiyah and Suwaib.

The T. vulgare wheats consisted mainly of the small red chaff bearded with amber grain (No. 22) and the smooth white chaff bearded with red grain (No. 13) Felted white chaff bearded with red grain (No. 18) was also common whilst two other characteristic types were felted red chaff bearded with black awns (No. 32) and felted chaff bearded with black awns and felted white chaff bearded with black awns (No. 27).

The Macaroni wheat would appear to consist of the smooth red chaff with amber grain called Koola in Amarah together with the smooth white chaff with black awns and amber grain known as Reshgul in Mosul.

The barleys were well represented and complete set of those forms observed in Mesopotamia was collected, *viz.*:—

2 rowed	White	Chevalier	rachilla	
2 ,,	Black	,,	,,	
2 ,,	White	Fantail	(H. Zeocriton)	*vide* Plate 6.
4 ,,	Black			
4 ,,	White			
6 ,,	,,			

NASIRIYAH AREA.

A probably complete collection of the Nasiriyah wheat (Suq Samawah) was made by the Circle Officer in April, 1919, and he was kind enough to let me have specimens of his various types. In spite of the number of types present only 3 or 4 were of any general occurrence. Severe damage from rust was experienced and the smooth white chaff beardless (Gareita Buwethah) was held locally to be the most susceptible.

A curious contract to the reputation of a similar type at Zobeir and on the Upper Euphrates for rust resistence, Hamera the preponderating commercial wheat (20, 21, 22) was also however very badly attacked. The Karun wheat on the Demonstration Farm had been badly hit but Punjab 11 and Punjab 15 imported from India had practically escaped a fact that did not escape the observation of neighbouring cultivators. Wheats characteristic and peculiar to this tract were (*a*) a beardless smooth white-glumed wheat with a broadening apex to the ear (No. 1) and a smooth white chaff bearded wheat with awns and the upper part of the glumes a distinct purplish colour in the field (No. 26).

BASRAH AND SHAT-AL-ARAB.

Wheat in this area is grown entirely as a secondary crop under date palms where yields are thus not heavy: the wheats may be said to be a mixture of the Nasiriyah and Karun wheats together with a few Indian wheats imported shortly before the war in a year of failure on the Karun. As is to be expected from a crop grown by irrigation in the shade havoc wrought by rust in a rust year is tremendous: as observed elsewhere however the red chaff felted beardless wheat known as Gareita Hindia or Gareita Hamra showed considerable resistance to rust (Nos. 7 and 12).

QURNAH AND QAL'AT SALEH.

These areas were kindly surveyed for me by the Circle Officer, Amarah, as they were unapproachable owing to floods when I passed through. The Circle Officer, Amarah, forwards the following list of types grown:—

	Vernacular Name.	Photo No: of Type.
AWNED.		
(a) Felted—		
White glumed.		
(i) White grain	BINIA	19
(b) Smooth		
White glumed.		
(i) White grain	SHILEECH ABIUDH	16
Red glumed.		
(i) White grain	SHILEECH AHMAR	21
(ii) Red grain	HAMERA	20
AWNLESS.		
(a) Felted—		
White glumed		
(i) White grain	GAREITA BUWETHA	5
Red glumed.		
(i) White grain	GAREITA HAMRA	11
(b) Smooth.		
White glumed	GAREITA BUWETHA	1-3

AMARAH WHEATS.

The Beni Lam being above all wheat and barley cultivators I relied mainly on them for local lore connected with these crops and they showed considerably more knowledge and interest than one usually finds in connection with such subjects. They confine their energies to four types all of which can be found growing more or less pure.

HAMERA or UMM EL FEES ... ... A red chaff bearded smooth.

BUWETHA ... ... An amber white chaff smooth.

DEGHAIMA ... ... A red chaff felted awnless with red grain probably originally Indian (GAREITA) HINDIA. (*Vide* No. 10).

WUTHNAH ... ... A lax eared red chaff bearded of remarkable size and length of ear (*Vide* No. 20). It is very strong in the straw.

DEGHAIMA showed considerable rust resistance and had a fine dark red semi-translucent grain: certain strains of WUTHNAH have also fine red grains and show slight rust resistance.

Crossing to Kumait River Bank one meets for the first time in commercial quantity SFAIRA a white chaff smooth bearded and this with HAMERA and WUTHNAH forms the bulk of the crops out to Shaikh Turki.

HAI AND SHATT EL GHURRAF.

In this area more attention would appear to be paid to seed selection and wonderfully pure crops of Hamera and Gareita Buwetha were met with. Although the cultivator here fails to distinguish between Hamera and Wuthnah, I am satisfied that the difference exists here as distinctly as it does in Amarah.

While rust did considerable damage on the Ghurraf in 1919 nevertheless crops both there and round Kut were above the average for the country: the whole area struck one as very prosperous: factors contributing towards this prosperity are probably rich soil, lesser liability to disastrous floods than similarly situated areas on the Tigris and Euphrates and freedom to flood low lying areas for the production of summer grazing and for the growth of Chibis crops.

A wheat peculiar to the Ghurraf was a smooth white chaff bearded that stood out in a crop owing to the brilliant yellow colour of the ripe ear (*vide* No. 15).

KUT AREA.

Indian wheat seed seems to have taken more hold here than elsewhere and this made collection of really local types somewhat difficult. Hamera (*vide* No. 22) and Sfaira (*vide* No. 13) formed the bulk of the crop, with an occasional ear of a Durum Wheat (*vide* No. 41) and an occasional white chaff wheat with black tinted glumes and awns (*vide* No. 26): in fact this type and mixture of crop is general within the area of Kut, Shahroban, Beled, Musayib, Diwaniyah.

It was noticeable around Kut that seed of Indian origin showed marked rust resistance, probably on account of the fact that imported Indian varieties mature earlier than local types.

The only pure Durum wheat crop observed during the Survey on the Tigris south of the Jebel occurred opposite Kut on virgin soil opened up to cultivation by the utilisation as irrigation channels of former trenches.

Three types of Durum wheat were obtained from this crop, which went by the local name of Hamayshiyah (*vide* No. 39).

AZIZIYAH AND BAGHDAD AREAS.

Were both very badly hit by rust in 1919 and these districts hardly furnished a well-grown wheat grain at harvest time. The crops are composed mainly of Sfaira and Hamera with odd ears of awned black-tinted white chaff (Soda Siffa and Durum (Harrima), odd ears of beardless white chaff (Gareita Buwetha) and beardless red chaff (Gareita Hindia) are also met with.

In and around Baghdad district itself pure crops of beardless red (Gareita Hindia) are grown under lift irrigation: the wheat was apparently imported by merchants from India about 9 years ago and has been kept pure locally owing to its rust resistant powers: it has the reputation of wanting a good deal of water and this has probably resulted in its limited distribution. Smooth and felted chaff are very much mixed and the better quality felted chaff with red grain is being isolated.

Sumaichah, Beled and Samarrah distinguish a definite type of red chaff black-awned red grained wheat as Soda Siffa: the awns are short and stiff and stand out at right angles to the ear when ripe.

On an inundation canal south of Aziziyah L. Bank a pure crop of about 15 acres of 6 rowed barley (Spergalan) was noticed in the harvest of 1918: otherwise it has only been observed as odd ears amongst crops of 4-rowed white.

A 4-rowed white barley bought from India under the A. D. Scheme and distributed around Baghdad in December, 1918, produced wonderful strong strawed crops on lift and pump lands in the neighbourhood of Baghdad, whose owners obtained the seed in time to catch the season. On the canal lands where delivery was later results were not so encouraging.

The favourite barley is the 4-rowed white, while the 4-rowed black is also fairly popular: 2-rowed black (Abu Swaif) is popular amongst the lift cultivators of Tarmieh and Rushediyeh and continues popular northwards through the Dujail Canal area, through Samarrah and Tekrit into the regular daim areas of the Mosul Vilayat.

DIWANIYAH—HILLAH—MUSAYIB.

The average crop is similar to that of Baghdad-Kut tract but the occurrence of a larger percentage of smooth beardless white was noticeable: this beardless white (Gareita Buwethah) is the favourite among the lift cultivators from Felujah upwards: it is very early maturing and thus escapes a good deal of damage by rust but as with Gareita Hindia a reputation for requiring much water probably prevents its wider spread.

Cultivation through this tract seemed rather poor but allowance must be made for the compulsory cropping of land that has obtained here for the last two or three years. This has rendered most of the land foul with weeds and wild oats, while abnormal percentage of barley in the wheat are inevitable under such treatment. A great deal of the land in this area is getting a well-needed fallow this winter. Increasing salinity is also a factor inhibiting the growth of first class crops in this area.

The favourite barley of the tract is the four-rowed white (Araqi).

MOSUL VILAYAT.

The line of the Jebel Hamrin can be taken as the dividing line north of which it is not profitable to grow wheat and barley by lift irrigation owing to the general sufficiency of the rainfall.

Daim cultivation being the sole means of livelihood of numbers of villages it is carried to a fine art: the exclusively daim cultivator is known as the DAIMACHIYEH and his year is roughly mapped out as follows.—

January 25th.—All sowing finished.

January 28th to mid-May.—Ploughing of ground after rain preparatory to summer fallowing and sowing in the autumn.

Mid-May to mid-August.—Harvesting, threshing and marketing of crops.

Mid-August onwards.—Sowing seed on to the land ploughed in the previous spring (GA FELHAN), ploughing in of seed and cross ploughing. If these operations are complete before January 25th, the remainder of the year is occupied by sowing seed on uncultivated land, ploughing and cross ploughing in.

Seed rate varies from 40 to 60 lbs. per acre according to soil and situation.

To the average cultivator two divisions of wheat only are known, *viz.*,:—KHUSHNA (the big or Macaroni) and KANDAHARI (the small grained bread wheats).

The Macaroni wheats formed about 80% of the 1919 wheat crop. Reasons for this preponderance are:—

(*i*) Greater yield
(*ii*) Greater drought resistance
(*iii*) Greater resistance to rust
} as against KANDAHARI.

It will be seen that whereas in pre-war days wheat prices would oscillate between As. 8 and Re. 1 per Mosul Wuzna of 30 lbs. (*i.e.*, Rs. 37/8 to Rs. 75 per ton) while the enhanced price of Kandahari over Khushna rarely exceeded As. 1 per Wuzna (*i.e.*, Rs. 4/11 per ton). The Khushna with its greater yield and resistance to drought and rust was the more profitable crop to grow. This preponderance can but continue therefore until the market will pay the price for extra quality or until a rust resistant bread wheat is introduced.

This preponderance of Macaroni wheats has its effect on the local diet which consist largely of "BURRGHUL" instead of bread. The burrghul is made by scolding the whole Macaroni wheat, drying it in the sun and then cracking off the outer skin of the grain (bran) in specially constructed stone mills: after the bran is winnowed out the Kernels obtained are treated exactly like husked rice and it does not require a great deal to constitute a most filling meal.

In the villages black barley bread is most commonly eaten: if bread is made from Macaroni wheat the variety RESHGUL (No. 38, 39, 51) is preferred while SURGUL (No. 46) is said to make the best burrghul.

Types of Wheat in Mosul Vilayat.

T. VULGARE.

Kandahari.—No distinction is recognised between the red and white glumed varieties, both are smooth-glumed and the white glumed is identical with the SFAIRA of Lower Mesopotamia while the red glumed is the same as the HAMERA of these parts.

T. DURUM.

The difficulty of obtaining a purely Arab nomenclature for the local varieties of these wheats is great as the languages spoken within very small limits are Arabic, Chaldean, Kurdish and Turkish.

Three outstanding types which were in sufficient quantity to constitute pure crops in places were in order of importance (*i*) a smooth white chaff with black awns known as BUWETHAH and BEZR GEHISH (Arabic) and RESHGUL (Kurdish) (*vide* No. 51); (*ii*) a smooth red chaff with black awns known as SURGUL (Kurdish) HAMRA (Arabic) and KHAMRIQ (Turkish) (*vide* No. 46); (*iii*) a smooth black-glumed black-awned variety known as RESHGUL (Kurdish) KARA KULCHAK (Turkish) and SODA SIFFA (Arabic) (*vide* Nos. 38, 39).

Felted ears of (*iii*) were also found (No. 47) but were of rare occurrence and had no distinction on local nomenclature. A T. Durum wheat with grains about 9 mms. long and a very long lax ear was also found No. 50). Its local name SINN EL FIL or Elephant's Tusk, appears rather appropriate.

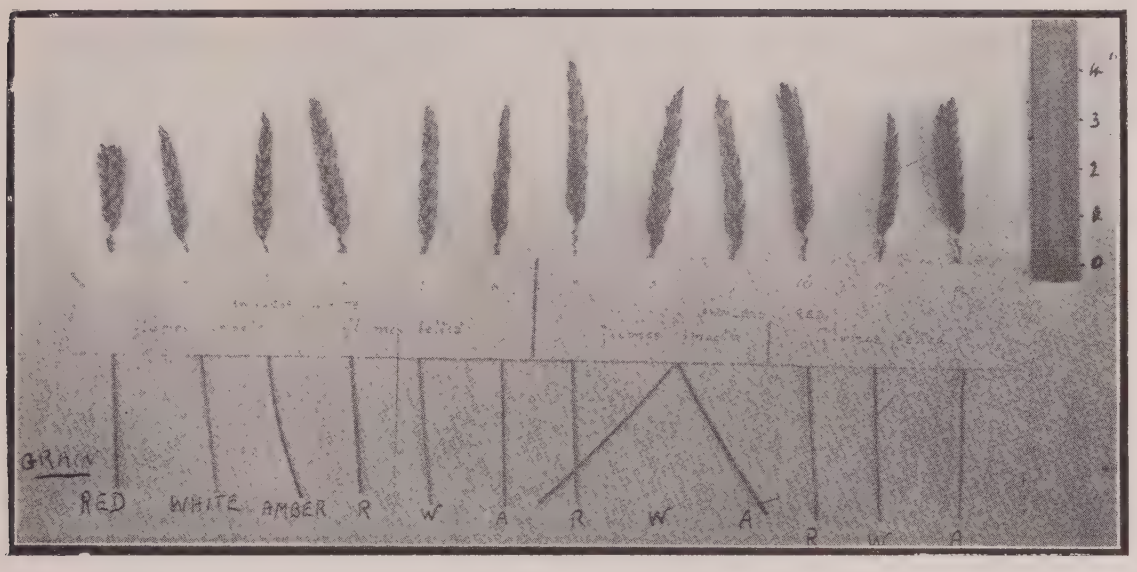
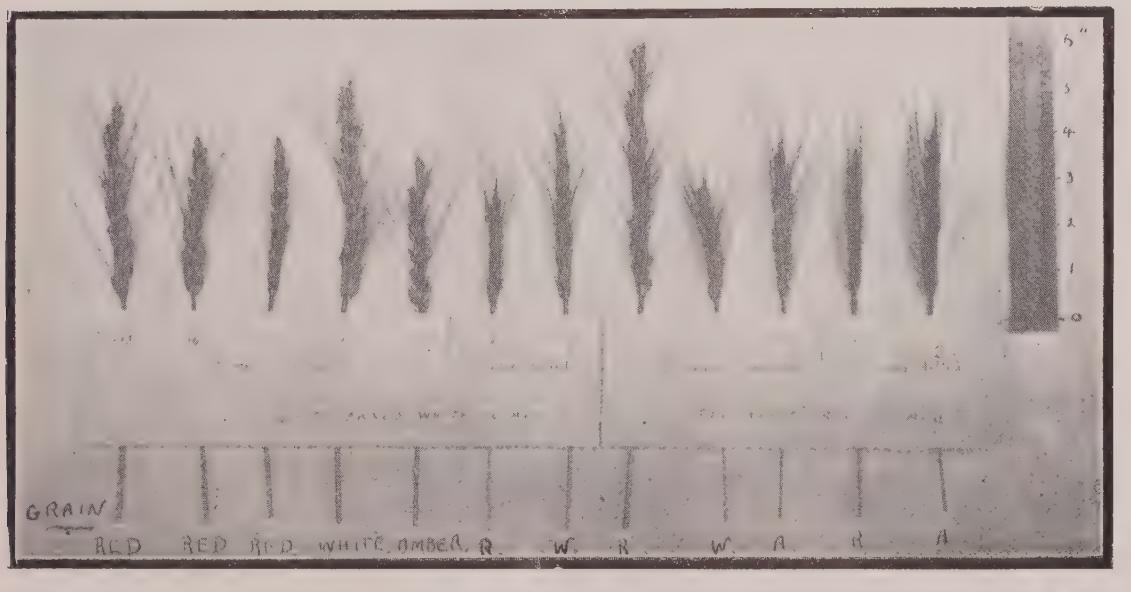


PLATE 1. **T. VULGARE.**



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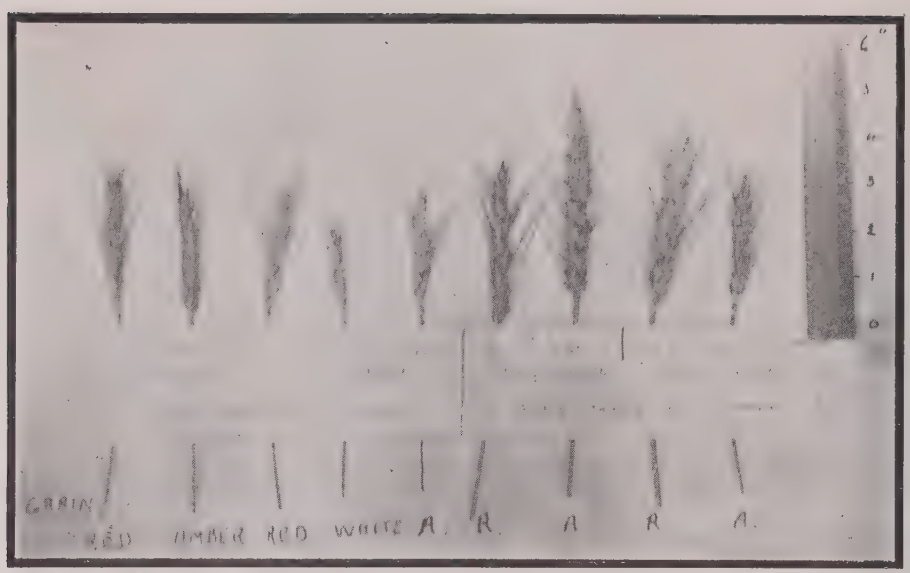

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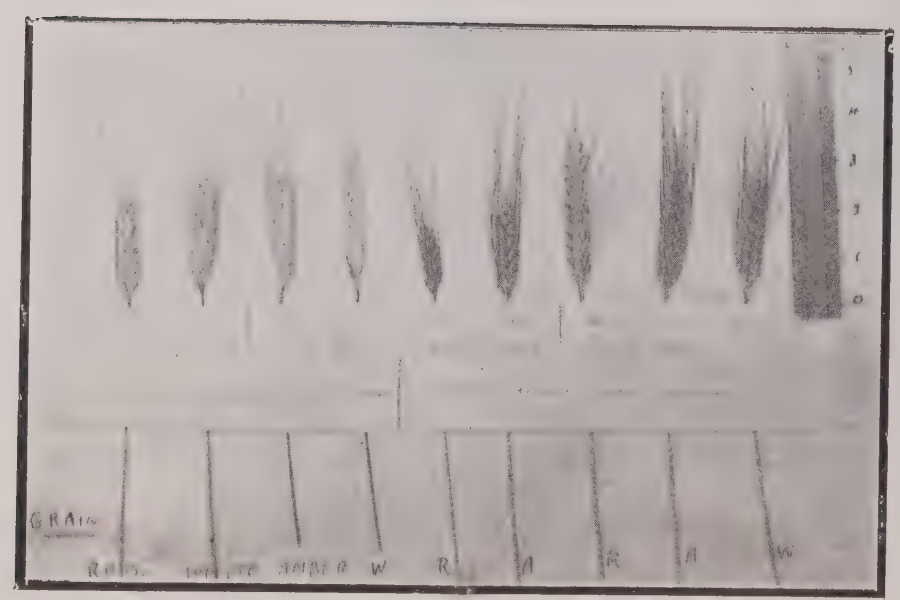

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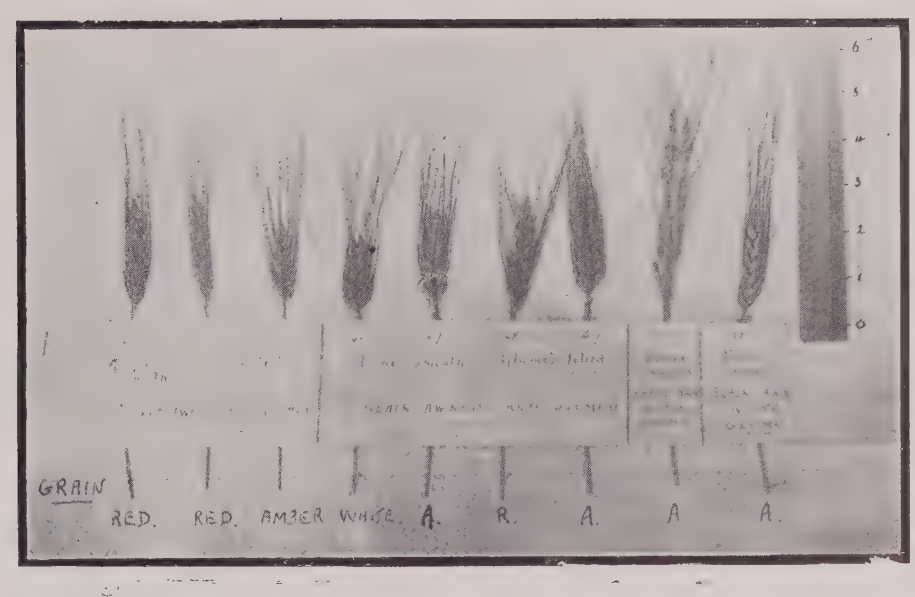

PLATE 5. **T. DURUM.**

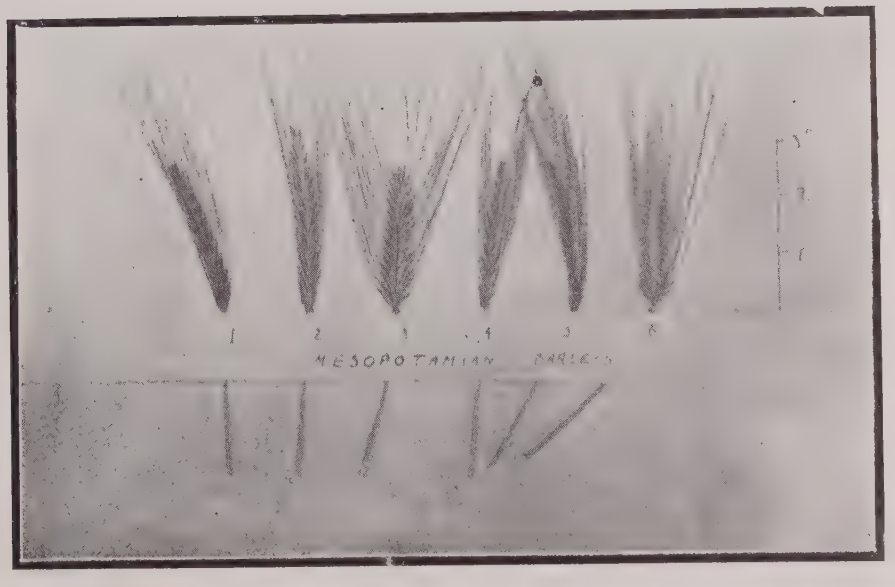

PLATE 6. **BARLEYS**

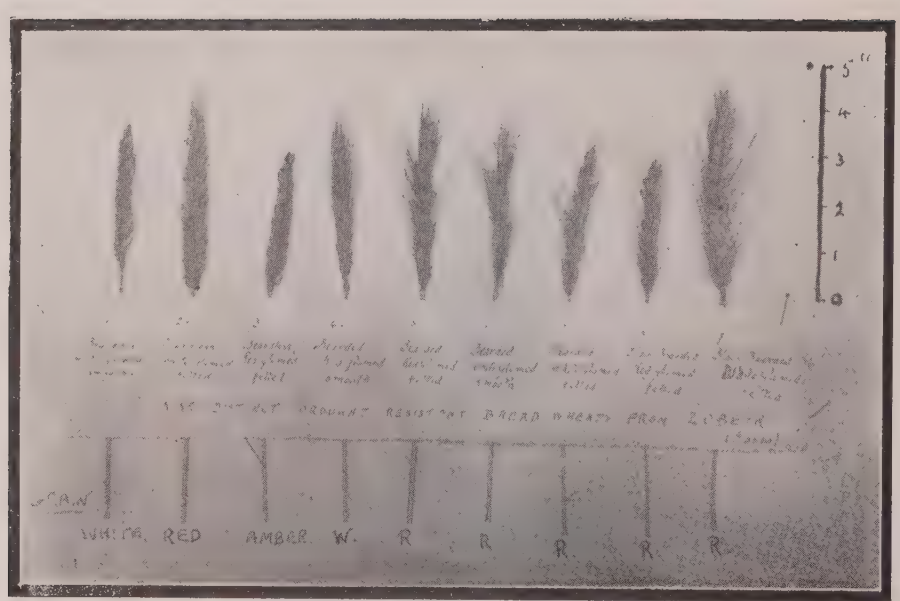

PLATE 7. ZOBEIR WHEATS

Cultivation Practice.

The various methods of bringing the wheat and barley crop to maturity may be grouped as follows:—

(*i*) By means of natural rainfall only (Daim cultivation), *e.g.*, the Karun river area and the Mosul area.

(*ii*) By means of residual underground water remaining after the drying up of a flooded area, supplemented by natural rainfall (Chibis cultivation) *e.g.*, the Akkarkuf area after the 1917 flood from the Euphrates and areas along the Ghurraf.

(*iii*) By means of lift irrigation supplemented by natural rainfall as practised along the river banks throughout the country. Between Ctesiphon and Sindia on the Tigris, lift cultivators can generally depend on being able to give one or two good soaking waterings with flood water during April.

(*iv*) By means of natural rainfall supplemented by flood water in spring, *e.g.*, the area between Qal'at Saleh and Ctesiphon. The further north one goes the greater the uncertainty of the height of the flood level sufficing to irrigate the whole of the area sown. The Dujail canal taking off the Tigris from Istabulat and irrigating Beled and Sumaichah is capable of giving water between the limits of late November and the third week in June owing to the depth and length to which it has been dug: it did not commence to flow this year till January 30th, so that reliance had to be placed on natural rainfall to soften the land for ploughing and sowing as in the case of other inundation canals.

(*v*) By means of irrigation water from perennial canals supplemented by natural rainfall, *e.g.*, the great canals taking off from above the Hindiyah barrage on the Euphrates. This confers the great advantage of ability to soften the land for ploughing in the early autumn and to sow at the optimum season. All other tracts are dependent on the first rain for ability to start ploughing and sowing, so that late rainfall has a marked influence on the area sown.

It is a noteworthy and important fact that quality, rust resistance, and very often yield per unit area, tend to be adversely affected by plentiful water supply: Daim crops (*i*) come first in order of quality, followed by Chibis (*ii*), Lift (*iii*), Inundation Canal (*iv*), and Perennial Canal (*v*), in the order mentioned.

This fact may be accounted for by the tendency of cultivators with a plentiful water supply at their command to "Skimp" their cultivation operations and make up deficiencies in this respect by "slopping on" the water, a practice which on an alluvial soil extremely liable to "cake" after irrigation and even rain is deplorable. This practice of wasteful use of water is fast turning perennial irrigation tracts saline and it is difficult to see a method of checking it so long as collection of Revenue as a portion of the gross crop is continued: assessment of land at a definite sum per unit area according to soil, water, and marketing facilities combined with a unit area charge per irrigation is more likely to bring about careful use of water than any amount of fining or demonstration of more economic methods of cultivation. A definite charge per irrigation per unit area would mean that the cultivator would try to get as much as he could when the rotation came round but he would try to lengthen the interval between irrigations: in attempting this a realisation of the extraordinary effect of breaking the surface by harrowing after rain would not take long to sink in: the advance to the use of harrows is not a very big one for the use of brush and log harrow in smoothing over a seed bed is already well-known. There is every indication that in perennial irrigation tracts not already affected by salinity the operation of breaking the surface "cake" after rain by harrowing could cut down necessary irrigations for wheat and barley to two, one in the late autumn prior to immediate deep ploughing (Turbis) and one in early April at the time of appearance of the wheat and barley ears.

The cultivators' objection to refrain from irrigation directly after sowing is due to his experiences of the ravages of birds notably sandgrouse and the black crow, which can do much more damage in picking out and scratching up seed from loose soil then from a soil sodden by irrigation water. A large species of black ant also occurs, which is able to collect seed resting in loose soil into accumulations at intervals, thus producing a very uneven crop.

The cultivators on the inundation canals between Ctesiphon and Kut are obliged however to work under the conditions of loose seed bed and they have not even the advantage of a preliminary irrigation stored under ground. These cultivators manage to get crops by a slightly higher seed rate and the black ant is of rather local occurrence only, so that the practice of leaving the wheat and barley to establish itself in a loose surface seed bed is to be recommended for perennial canals also. In a rust year at any rate irrigation immediately after sowing does a good deal more harm than good owing to the fact that a crop plentifully supplied with water at the start does not trouble to produce a root system and remains thirsty all its life while a crop that has had to establish itself on a small supply of moisture is obliged to develop its root system to the utmost and is able to mature on a minimum water supply.

This treatment of cutting down water supply of a wheat crop to increase resistance to rust is also beneficial when applied to barley in that it tends to produce better quality and stronger straw that will not "lodge" so badly after late spring rains.

The manner in which a surface "cake" after irrigation and heavy rain tends to restrict growth would not seem to be entirely explained by lack of soil aeration brought about by caking of the soil surface: in this connection an observation of C. M. Hutchinson, Esq., B.A., Imperial Agricultural Bacteriologist in Bulletin No. 68 of the Agricultural Research Institute, Pusa, on "Saltpetre: its origin and extraction in India," is of interest. I quote verbatim from page 8:—"Thus it has been found as a result of observations made in connection with this enquiry, that during the cold weather in Bihar, when the Rabi crops are in ground, the nitrate formed in the soil is brought to the surface by the capillary rise and evaporation of soil water, so that in an untilled soil, about 90% of the whole of nitrate present in the first 18 inches of the soil is concentrated in the first quarter inch. This emphasizes the necessity for cultivation during this period of the year not only to minimize loss of water by evaporation but to prevent the concentration of the available nitrogenous plant food in such a superficial layer and the consequent formation of a shallow root system so characteristic of plants in a badly cultivated soil and especially noticeable in the case of cold weather cereals of normally deep rooting habit such as wheat."

Observations in the field indicate that it is to the modified occurrence of the above phenomenon in this country also, that the extraordinary benefit to winter crops resulting from a harrowing of a surface soil "cake" just before the latter has hardened, can be attributed.

Daim Cultivation.

The study of the crops of wheat and barley produced on a rainfall of between 6 and 8 inches in Lower Iraq in years when such rainfall is evenly distributed is of very great interest: it may be considered that, inasmuch as the area under daim crops south of the Jebel Hamrin bears a negligible proportion to the corresponding area under irrigated crops the subject is of not very great importance.

When one considers however that in 1918-1919, a bad rust year, better crops of wheat were produced by Daim cultivators between Baghdad and Khan Beni Saad than were produced under lift irrigation conditions in the Baghdad district, it will be seen that the cultivator of irrigated lands has a good deal to learn from a consideration of daim conditions.

To start with, it appears little short of marvellous that a cultivator with a small plough that will hardly go below 3 inches can, without previous cultivated fallow, on land in certain situations, plough, sow and cross plough with the first rains from the end of November onwards and with any luck reap his crop in early May without troubling any further. When one considers that his seed bed is by no means ideal and loss of moisture takes place by surface caking after every rain while residual moisture from the previous year's rainfall must be considered as negligible the success of such a daim crop in any year can but denote a remarkable coincidence of favourable conditions, *viz.*:—

(*i*) Rainfall taking place fairly evenly spread throughout the growth period of the plant.

(*ii*) Comparatively low evaporation during the growth period of the plant.

(*iii*) The supplementing of rainfall by heavy dews.

While in many cases, such as the bed of the ancient Nahrwan Canal behind Azizíyah, a favoured daim area is situated in a depression and obtains more than its natural share of the rainfall by surface drainage from its suroundings, nevertheless when one considers

such flat tracts of land as those, for instance, lying between Mushahdie Railway Station and Tarmiyah on the Tigris—a noted daim area—one is forced to admit that the production of a wheat and barley crop in alluvial 'Iraq, on nothing but the natural rainfall of between 6 inches and 8 inches, is a proved possibility. With a view to testing the beneficial effect or otherwise of a cultivated summer fallow previous to sowing of a daim crop a rough experiment was tried in 1918 at Dabaghieh using a drought resistant strain of 2-rowed black barley (Abu Swaif) from Sumaichah.

Half acre was ploughed in late April while the ground was still soft from the last of the rains and left fallow all the summer. In the following November an adjoining ½-acre was ploughed soon after the rains had started: seed was then ploughed in to each ½-acre plot, at the rate of 40 lbs. per acre.

The soil proved to be somewhat sandy and neither plot matured its crop but the plot that had received its first ploughing in the previous April made *less* vegetative growth than the plot ploughed first in November according to local practice, the line between the adjacent plots being quite distinct.

A perusal of Bulletin No. 1 of the Central Research Farm, Khartoum North, showed that arid soils under a long summer fallow tend to revert to desert conditions of negligible humus content owing to rapid oxidation of organic matter.

In view of the high lime content of the alluvial soil of 'Iraq and of the fierceness of the summer heat there is little doubt that all organic matter present in a soil in April would be most thoroughly oxidised and dissipated if the soil was left fallow and cultivated till the following autumn. The daim cultivator on the alluvial soils therefore is probably quite right in refusing to follow the example of his neighbours across the Jebel Hamrin, farming non-alluvial soils. In the latter districts (*i.e.*, Kifri, Karkuk and the Mosul Vilayat) lime content of the non-alluvial soils must be considerably lower than that of those of Iraq alluvium or the success of the summer fallow as at present practiced in the North should not be possible.

The application of dry farming methods of moisture conservation from year to year, to the alluvial soils of 'Iraq for the improvement of daim cultivation therefore depends on the feasibility of the addition of some form of nitrogen to summer fallowed land just prior to sowing in autumn.

Sowing Season.

WHEAT.

Daim crops on alluvial soils are sown from the date of the first rain experienced, sufficient to moisture the soil for ploughing, till about the first week in January.

Irrigated crops are sown from the latter part of November till early February. If the rains do not come by late November on perennially irrigable or lift lands the soil is artificially moistened for ploughing: on these lands there is a belief that a surface irrigation given to wheat before the first appearance of the star Es Hel (which occurs about the third week in November) predisposes the crop to damage by rust: observation of the rank growth obtained by such treatment tends to corroborate than to refute this belief. Inundation canal areas being entirely dependent on the first rains for their sowings sometimes get let down rather badly and have to sow very late as has happened this year in the Ghurraf.

The Beni Lam consider they can go on sowing in case of necessity both wheat and barley as late as Nau Ruz (March 21st).

Cultivators on the Abu Ghraib canal maintain that they have sown their own local wheat and Dukhn (Panicum miliaceum) at the same time: this would put March 1st as the possible latest date for the Felujah-Baghdad tract. Yields from these late sowings are of course small but the cultivator on the inundation canals must make the best he can of his luck with the rainfall. Latest date of sowing for wheat practised on the daim lands of Mosul Vilayat, Karkuk and Kifri is about January 25th. In no case has the taking a preliminary green cutting off a wheat crop been observed: horses may be run over for a short nibble at the end of February but as a rule even this practice is refrained from.

BARLEY.

As soon as the first black crow arrives, dating from mid September onwards according to season, the Arab realises it is about time to sow his first barley: the early sown barley is sown mainly for green fodder and with luck two good cuttings can be obtained without risk of injuring the young ear: the final crop produced from the green fodder sowings is generally rather poor certainly not more than half that from an untouched crop sown in

late November and early December. This green fodder crop is confined to lift and perennially irrigable flow lands which can get water before late November.

With the exception of these early green fodder sowings the remaining sowing times for various districts correspond with those of wheat (q.v.)

It is noteworthy however that the Beni Lam in Amarah would prefer to finish up their sowings with barley, while the practice around Baghdad is to sow barley first and finish up with wheat. Imported wheats and barleys to be given a fair test should not be sown later than the end of December.

Imported Material.

During the stress of war operations a considerable quantity of Indian wheat and barley seed was distributed all over the country: the first big importations did not arrive till late December, 1917, and early January, 1918, so that a good deal of it did not get sown till well on into February, 1918: it thus had hardly a fair chance and gained rather a bad name through the country. One or two cultivators immediately around Baghdad got their seed in before the end of December and were very satisfied at results especially in the case of barley.

The barley seed imported was a good quality pure 4-rowed white, a heavier yielder and stronger strawed type than the local 4-rowed white.

The Indian wheat seed however was very mixed in variety and it is almost inevitable that in last year's survey, odd ears originating from this war time seem import have been collected as local types and in a way, such they have now become. In 1918, too, very little damage was due to rust throughout the country, so that these Indian imported varieties did not get their fair share of attention.

For the 1918-1919 crop however Punjab 11, dark red chaff, smooth bearded and Punjab 15, dark red chaff felted beardless were imported by Dr. Evans, Director of Agriculture, and sown everywhere under supervision: in one of the worst rust years on record they both did very well as a whole through the country: on the Baghdad Dairy Farm owing to unstinted irrigation both were practically wiped out but at Khan Beni Saad where the crop was subjected to a 60-day drought in the Spring owing to the water shortage, Punjab 11 especially, did very well: similarly at Nasiriyah, Hillah, Baqubah, Kazimain and Samarrah, Punjab 11 also came out very well and demand for seed for local cultivations was considerable. It is said to have done very well under daim conditions in Khaniqin and is being tried in Mosul this year: if, as there is every reason to suppose it will be, Punjab 11 is successful in Mosul Vilayat an enormous amount of time will be saved and the daim lands of Mosul will in a very short time have an exportable surplus of wheat suitable for European markets. Apart from the one undetermined factor of drought resistance Punjab 11 possess the desirable characteristics of good yield, strong straw, awned ears and grain of good baking quality. The grain hardly comes up to the small red of rather flinty cross section that catches popular fancy on the London grain market but it is becoming more and more realised now, that eye characteristics are little more than an indication of baking quality. Punjab 11 although possessing a biggish whittish grain has passed successful baking tests, is appreciated out here for its good baking qualities, and is getting well known on the London market.

With the Railway through from Aleppo to Mosul it will be possible to put Mosul wheat on the sea at Beyrout or Alexandretta as cheaply as the Punjab cultivator can put his produce on the sea at Karachi and that means a good deal to the future development of the Mosul Vilayat.

Turning to the irrigated tracts of alluvial 'Iraq there is every indication that in Punjab 11 the cultivator has at his disposal a wheat superior to anything he had previously: with careful restriction of irrigation water it has proved itself to possess very marked rust resistance. The opinion is expressed that no variety of wheat exists that could stand up against a rust epidemic similar to that experienced last year under conditions of over-irrigation and under cultivation such as exist over the greater part of the country.

On these grounds however there is no justification for assuming Punjab 11 as good enough and the search for better material has to continue.

Thanks to the continued lively interest in the subject taken by F. L. Engledow, Esq., of Cambridge University, the Department has been supplied with a fine selection of drought and rust resistant wheats from England, South Africa and Australia, including samples of the prize-winners at the last Commonwealth Exhibition. Mr. Engledow has kindly sent ears and samples of the following wheats:—

1. Rietti.
2. Persian Black. Resistant to Erysyphe graminis.
3. Little Joss, Prof. Biffen's famous Rust Resister for English conditions.
4. Kubanka Parent.
5. Black Don.
6. Long Korn.
7. Polish Parent.
8. Firbank.
9. American No. 8.
10. Wit Klein Korn.
11. Comeback.
12. Toogood's White Victor.
13. Toogood's Squarehead Success, noted for strong straw.

Also:—

E. 24. Cedar.
E. 25. Cedar.
E. 26. Redwing.
E. 27. Comeback.
E. 28. Kubanka.
E. 29. Indian Runner.
E. 30. Comeback.
E. 31. Comeback.
E. 32. Canberra.
E. 33. Florence.
E. 34. Yandilla King.
E. 35. Florence.
E. 36. Purple Straw.
E. 37. Jade.
E. 38. Worren.
E. 39. Comeback.
E. 40. Steinwedel.
E. 41. Worden.
E. 42. Canawa.
E. 43. Marshall's No. 3.
E. 44. Mason.
E. 45. Roseworthy.
E. 46. Federation.
E. 47. Jade.
E. 48. Yandilla King.
E. 49. Bayah.
E. 50. Federation.
E. 51. Jade.
E. 52. Buniyif.
E. 53. Cleveland.
E. 54. Zealand.
E. 55. Eeroa.

All the varieties arrived in time to be sown before the end of December alongside the local types, so they will get a fair chance: all are now growing well and the Australians especially are going ahead strong. For a start, rust and drought resistance and grain quality are the attributes being tested: yield and rust resistance under irrigated conditions will remain to be enquired into.

Diseases Attacking Wheat and Barley.

WHEAT.

First and foremost comes *Rust* due to Puccinia Graminis and Puccinia Glumarum. both these have been definitely identified Puccinia Triticini, has not as yet been definitely recorded. A redeeming feature of the Rust epidemics appears to be that they are late in their incidence so that the character of early maturity in a variety is of great benefit in helping it to resist attack.

As far as present limited experience goes, it would appear that danger from rust is greatest in a year of copious early rainfall followed by a mild winter such as was experienced in the season 1918-1919.

In the previous season, 1917-1918, the first rain did not fall till the last week in November while a 12-degree frost was recorded at Baghdad in the second week of December. The harvest of 1918 was one of the best on record and damage due to rust was negligible.

Arguing from these precedents the present season should show no great losses from rust: the first rain did not occur till well on into November and there have been cold snaps right through the winter: no degree of cold corresponding to the 12 degrees of frost of December, 1917, has however been experienced.

A noticeable feature last harvest was the fact that although wheat crops throughout 'Iraq were badly smitten by rust right up to the Persian border beyond Khanaqin nevertheless the great areas between Kermanshah and Hamadan produced rust free healthy crops: ears of these wheats were brought down by Captain Barker in July, 1919, and have been sown alongside local types: it is not expected however that these wheats have marked rust resistant powers: circumstances point rather to the fact that they were in an environment unfavourable to the development of rust owing to the previous severe

winter. This suggests the subjection of seed to low temperatures before sowing but it is probable that the whole soil in which a crop is sown as well as the seed itself must be subjected to a hard frost before the environment is produced unfavourable to the development of rust.

SUN OR ERGEYJA, A PENTATOMID BUG.

Comes next in importance as a pest of wheat: it appears mainly confined to the Mosul Vilayat and in view of the fact that the rust problem promises to be comparatively easy to combat in this area Sun promises before long to be the major pest of wheat in the Mosul Vilayat: it does not appear to have been described previously and local tradition provides the following information:—"It comes down from the foothills in early March, lays eggs on young grasses, barley and wheat: these eggs gives rise to a brood which causes damage by sucking the juices from the heart of young shoots: on maturing the pest would seem to confine its attention purely to the ripening wheat ears on which it is found sucking the juices from the maturing grain. The resulting grain is consequently shrivelled and of poor quality. As the wheat is harvested in June the pest is said to migrate the foothills not reappearing in the plains till the following March."

In a crop of Durum Wheat observed at Tel Uskof, a Christian village north of Mosul, last June, nearly every ear was being sucked by the Sun Bugs: after a crop was harvested they all disappeared very rapidly and search in the soil failed to reveal them in dormant stage: it is probable therefore that they follow season of the ripening corn right up into the hills and hibernate there.

The discovery of mature Sun on maturing wheat at Baghdad on 5-4-20 points however to other hibernating localities.

ELWORM.

Causing ear "cockles," is fairly well distributed throughout the country: infected grains can be picked out of almost any Bazaar sample. Loose smut is of similar general through slight occurrence: in steeping seed for smut in a 2% solution of copper sulphate the majority of the ear "cockles" can be skimmed off the surface of the liquid, if treatment is not prolonged.

Wheat Stem Maggot, Wheat Leaf Miner Maggot, and Minute Red Wheat Thrips also occur but damage is trifling.

Erysyphe Graminis has not been observed damaging wheat.

BARLEY.

Is slightly attacked by brown rust in a rust year, but such damage may be considered of little economic importance. Erysyphe Graminis and Helminthosporeum both occur but damage is also small in extent. Barley Stem Maggot and Barley Leaf Miner Maggot have also been reported but not as serious pests. Barley Smut is probably the most serious of the specific barley diseases but even that could not be said to cause appreciable losses through the country as a whole.

Barley in fact is as safe a crop as any as far as its own particular pests are concerned. The main losses occurring are due to weak straw character rendering the crop so liable to "lodge" under irrigated conditions if late rains occur.

Pests Common to Wheat and Barley.

WIREWORM.

Not very serious its ravages being largely marked by high seed rates employed.

DECTICUS ALBIFRONS.

the large brown grass-hopper. Causes very severe losses though the latter are very variable from year to year; a curious fact about this grass-hopper is that it waits until the grain in the ears of both wheat and barley is hardening and turning yellow, before commencing to feed on them: the grass-hoppers can be found in swarms all over wheat and barley stacks awaiting threshing, feeding on the hard dry grain: they possess tremendously powerful jaws and have been observed to devour hard dry cobs of maize. When the attack is very bad and there is little hope of saving the grain in ripe condition, barley especially is often cut just before the ear hardens and stacked in small heaps ears inwards to complete ripening: grain resulting from such treatment is of bad colour and shrivelled but better than none at all.

DECTICUS ALBIFRONS, although a strong flyer especially at dusk is not migratory and rather local in occurrence breeding over scattered areas amongst the crops attacked: the hoppers are not gregarious so that poison baits probably offer the only hope of successful remedial treatment.

SCHISTOCERA PEREGRINA.

The yellow migratory locust known as JURRAD ASFAR or ABU NEJDI: the latter name would appear to signify origin in the desert of NEJD which would make preventive treatment very difficult: these locusts do however breed to a large extent within the boundaries of 'Iraq and swarms of hoppers have already been reported this year from BEDRA and GAYARA. The migratory swarms of locusts arrive very hungry and not quite mature when the corn is still green: if they settle on a crop for the night there is not much left when they move on next morning. In a thinly populated country like 'Iraq there is not much hope of combating migratory swarms of locusts and remedial measures must have as their object the destruction of the original hatching swarms in the spring while they are still in the hopper stage.

The Shoq Plant (Prosopus Stephaniana).

No survey of the wheat and barley cultivation of Mesopotamia would be complete without mention of the SHOQ—economically one of the most important plants of the country in its present low state of Agricultural Development. Nine-tenths of the plant or more being under ground it is apt to be overlooked, until, on the drying up of the winter herbage, it bursts forth in all its verdure over the desert to continue fresh and green till the coming of the cold weather causes it to shed its leaves as a thick dark mould on the soil.

The woody stems of the plant form a large proportion of the fuel supplies of the country while but for the grazing obtainable from its green leaves through the summer the country's flocks of sheep and goats could barely exist.

SHOQ is a fine indicator plant, for SHOQ and good land are inseparable: along the river banks it occasionally becomes so thick as to constitute a nuisance but a good crop always awaits the cultivator who troubles to clear it away and sow the land beneath it. The bulk of the area served by inundation canals is largely dependent on the SHOQ to rejuvenate the land year by year.

The manner in which SHOQ acts in rejuvenating the land is fairly clear: its root system examined to a depth of 6 feet reveals very few feeding rootlets while it possesses no leguminous nodules: it is clear therefore that it draws its moisture and food from depths of the soil right out of reach of the ordinary cultivated crop: in the winter SHOQ roots may be seen on the river banks extending 12 and 15 feet below the soil surface.

When the corn is being cut the SHOQ is beginning to grow away and by the time harvest is over many corn fields are green again with SHOQ: the land is thus protected from fierce winds and sun through the summer by a plant drawing its nourishment and water from 10 and 15 feet below the surface. When the cold weather comes the SHOQ leaves are shed as dark mould over the soil surface thus adding supply of humus at the end of summer at a time when the humus content of the soil can but be low.

If is doubtful if crops of leguminous herbs grown on the rainfall in spring, ploughed in and left in a cultivated bare fallow all the summer, would have supplied more nett humus to the soil by November than a crop of SHOQ.

When one starts intensive farming on a perennial canal with such crops as cotton, SHOQ may appear a nuisance but for the inundation canal farmer dependent on his river flood, sheep and corn the SHOQ will be indispensable for a long time to come.

When the KHARNOOG or fruit pod of the SHOQ is fed to sheep the hard seeds pass through the animal's body uninjured but more ready to germinate and many unproductive though non-saline soils have been observed whose fertility could with advantage be improved with an initial sowing of SHOQ, which is able to establish itself in the rainfall.

Summary.

Future work on wheat largely resolves itself into a search for rust resistant types. In view of the early maturity observed in most imported varieties and the vigour with which the latter grow here, it is probable that import and distribution after growing on seed farms, of types well known for quality and yield in other countries will be able to place in the hands of the cultivator an exportable wheat, years before new types can be built up selection and crossing from local material.

Better cultivation and less irrigation can be a potent factor in restricting damage due to rust: improvements in method must however start on the perennial canals and lift lands: the inundation canal areas typified by the Ghurraf and Amarah areas still produce the major part of the country's corn and methods practiced on these lands can undergo little change till perennial irrigation is introduced: the inundation canal cultivator has a great stand by in his sheep when a rust epidemic occurs: having the range of wide areas, in a rust year when grazing is sure to be plentiful, he can make up any losses on his corn crop by production of large supplies of Ghee.

A point which has not yet been cleared up is the failure of the cultivator of irrigated lands to make greater use of the T. durum wheats which show marked rust resistance even under irrigated conditions: one pure crop only of about 10 acres was observed in irrigated tracts during the wheat survey of last year. T. durum wheat is certainly hard to sell in Lower 'Iraq but it would appear that in a rust year a loaf of T. durum wheat was better than no loaf at all: as a matter of fact after a rust epidemic the cultivator lives on barley bread; perhaps he prefers that to bread made from T. durum wheat, but he will give no consistent reason.

Work on barley must needs pay attention to straw strength and yield. Here again as with wheat the success of barley imported from India and sown in season in December, 1917, points to the fact that an imported barley producing crops suitable for export can be placed in the hands of the cultivator, years before as good as one can be produced by crossing and selection from local material

With both wheat and barley however testing of imported types and production of improved types from local and imported material must continue simultaneously.

It appears that organic nitrogen supplies in Mesopotamian alluvial soils require very serious attention and that before the eradication of Shoq can be advocated, an efficient substitute should be at hand to replace it.

The Agool (Alhagi Maurorum) or Camel thorn also has a considerable effect in increasing nitrogen supplies more especially on poorer sandier soils where Shoq establishes itself with difficulty: Agool appears to produce its effect owing to possession of leguminous nodules in the surface soil rather than by leaf shedding in the autumn, for in dry situations Agool is practically leafless.

The desirability of making use of the harrow for breaking surface soil "cake" after rain during the early stages of the growth of the wheat and barley crop cannot be over emphasized.

The short growth period at the disposal of wheat and barley crops grown on inundation canals makes the attainment of high average yields difficult of realisation.

Baghdad:

7-4-20.

APPENDIX.

METEOROLOGICAL STATISTICS.

BAGHDAD.

	Mean Rainfall in Inches. 1887—1918.	Mean Maximum Deg. Fahrenheit. 1888—1918.	Relative Humidity. 1889—1918.
January ...	1·21	59·1	78
February ...	1·16	65·2	73
March ...	1·23	72·7	69
April ...	·82	82·6	60
May	·2	94·0	50
June	.....	104·3	37
July	.....	109·4	37
August	·02	110·0	40
September	.....	103·4	42
October ...	·08	92·3	51
November ...	·90	75·0	66
December ...	1·23	62·8	79
	6·69	85·9	56·8

Growth period Wheat and Barley. ■